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ABSTRACT

This document presents the student's guide for an introductory physics course in electricity and magnetism for students in merchant marine and related degree fields. The unit is competency based and contract graded. The guide includes information on course objectives, examinations, an optional paper, laboratory sessions, grading, course content, and the course grade contract. (SL)

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INTRODUCTION TO PHYSICS (ELECTRICITY AND MAGNETISM) FOR STUDENTS ENROLLED IN MERCHANT MARINE RELATED DEGREE PROGRAMS

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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INTRODUCTION

Introduction to Physics (Ps-2) is a competency-based, contract-graded course. It affords the student the chance to work at his or her own rate and, in turn, allows the student the chance to decide upon the competency level which he or she wishes to attain. Further, it allows students to achieve to the same competency levels regardless of their learning rates. The students are cautioned, however, since the slower the student's learning rate, the more time he must invest in order to achieve a given competency level.

COURSE COVERAGE

The course deals with what Smith, A. W., and Cooper, J. N. (Elements of Physics, New York, McGraw-Hill Book Company, 1957) title "Electricity and Magnetism." It is to this section of Smith and Cooper that the student must attend, and to this academic area in general that the student must apply the majority of his or her effort.

Specifically, the course deals with Chapters 30 - Electric Charges at Rest; 31 - Potential; 32 - Capacitances and Dielectrics; 33 - Electric Current and Resistance; 34 - Electric Circuits; 36 - Magnetic Fields of Currents; 38 - Induced Electromotive Forces.

In-class time will be spent dealing with the concepts presented in these chapters. Progress through these chapters will be sequential according to the order presented above. All in-class lectures and discussions will be from a descriptive-mathematical perspective.

Lectures will be supplemented in several ways. First: there will be a two-hour laboratory session each week. Second: films, film strips, and video tapes may be used. Finally, the student is not only encouraged but should use the supplementary texts available in the library.

COURSE OBJECTIVES

The primary objectives of the course are two -

1. To provide the student with the requisite background so that he or she will be prepared for a more in-depth study of electricity and magnetism.

2. To provide the student with the requisite background so that he or she will be able to attack and deal with problems and problem situations related to electricity and magnetism.

GOALS

As a result of his study in this course, the student should be

able to apply the principles of electricity and magnetism to shipboard situations.

EXAMINATIONS

The course has three-hour examinations and a final examination. They cover the relevant subject material as follows:

EXAMINATION 1 Electric Charges at Rest; Potential.

2 Capacitances and Dielectrics; Electric Current and Resistance.

3 Electric Circuits, Magnetic Fields of Currents, Induced Electromotive Forces.

All examinations are multiple choice; however, in order to avoid test anxiety, which research suggests causes students to perform below their ability levels, all students will be allowed to take each examination twice. Each student must take the first of the examinations in each case. Participation in the second examination is an elective affair. Students electing to take a second examination over material covered in either examinations 1, 2, or 3, will take that examination on the day following the administration of the first examination. If a student elects to take a second examination, and attains a lower score on that examination, he or she will be awarded the grade obtained on the first examination. That is, the student will always be awarded the highest grade attained.

Each examination will be scored on the basis of 100 points and have 25 questions. Although the examinations are multiple choice, students will be expected to engage in computation, analysis of data, and the control of variables in order to obtain correct answers. In the event that the student does not achieve to his or her expectations, he or she may write an extensive outline of the material covered on each of the three-hour examinations. These outlines must be approved by the instructor prior to their being written; must not be taken from the class text; must involve at least two additional physics texts from the library; and must be turned in to the instructor not more than the second class day following the administration of the second examination. In no case will an outline be accepted later than the end of class on this second class day. Extremely well written outlines will raise a student's grade such that the combination of examination grade and outline grade will equal 100 points. Finally, all outlines must be neatly and clearly written, and follow standard outline format (I, A, 1, a, (1), etc.) Outlines which are not clear and coherent will not be graded.

The final examination will be administered only once; however, students may elect to write a major paper rather than taking the final examination. Whatever the case, the paper or the final examination will be graded on the basis of 200 points. If the students elects to write the paper rather than taking the final examination, he or she must do so during the first week of classes,

and the instructor must be so informed. The major thrust of the paper will be the application of principles covered in the course, inclusive text chapters to shipboard electrical systems.

While there is no specified length for the paper, it should be long enough to cover the topic adequately yet not so long as to be verbose. Normally, one should be able to cover the topic with minimum redundancy, in 18 to 20 double-spaced, typewritten pages.

Students electing to write a paper should use the following format:

INTRODUCTION

This section includes the objectives of the writer, i. e, why was the project undertaken.

METHODS

This section tells the reader how the investigation was conducted.

DATA

This section contains the information which was collected. It may be presented in properly labeled charts, graphs, tables, etc. The section may include charts, tables, and graphs which put together the data from several sources.

DISCUSSION

In this section the author discusses the data which has been collected. It may be compared with accepted theory and the current state of knowledge in the field.

CONCLUSIONS

This section includes conclusions based upon the data which was collected and the comparison of that data with theory and the current state of the art.

REFERENCES

In this section, the author cites any reference from which information for the report was taken.

The paper should be written in the third person, past tense. Remember, this paper concerns an investigation which has already taken place. Further questions concerning style, format, and citations may be answered by consulting a style manual. Several of these are

available at the Academy library.

Finally, the final examination for those who elect, will cover all of the material covered in both the lecture and laboratory sessions.

LABORATORY SESSIONS

Laboratory sessions will be held once each week for a period of two hours. The laboratory activities to be covered are (1) - investigating lines of equipotential; (2) - determining single capacitances and series and parallel combinations of capacitance; (3) - determining the resistance of single resistors and series and parallel combinations of resistance; (4) - using the wheatstone bridge to compute unknown resistances; (5) - determining the value of voltage of unknown batteries in single, series aiding, and series opposing configurations.

Each student is required to attend each laboratory session, maintain a field notebook, and submit a laboratory report for each laboratory session. Field notebooks are normally rough works which include observations taken during a scientific investigation, data collected during such an investigation, and any other information which might have a bearing upon the experiment's outcome. The Field notebook should be kept as neat as possible, and all entries should be made immediately after an observation, not several hours or days later.

Each laboratory report should be written, using the format provided above for the major paper. Reports should be submitted not later than the end of class on the third class day following the laboratory session.

Laboratory reports will be graded on a 20-point basis. Accordingly, 100 points will be allowed for the five laboratory reports. The grading of these reports will be according to the following scheme - 2 points for neatness, 4 points for format, 6 points for content, and 8 points for correctness.

COURSE GRADING

The course will be graded on the basis of 600 points. As mentioned above, each of three-hour examinations will be awarded 100 points; 200 points will be awarded to the final examination; and 100 points will be awarded to laboratory reports. Final grades will be awarded on the basis of 90% and above for an "A"; 80-89% for a "B"; 70-79% for a "C"; 60-69% for a "D". This means that one must accumulate between 540-600 points in order to obtain a grade of "A"; 480-539 points for a "B"; 420-479 for a "C"; and 360-419 for a "D".

Extra Points. A certain liability is incurred on the part of students who elect to take the final examination rather than writing the major paper, since the final examination will be administered

but once. In order to lessen this liability, students may elect to do a special project for extra points.

The project requires the critiquing of journal articles in the marine electricity field. Specifically, the student electing to do the extra project will be required to critique ten magazine/journal articles related to the use of electricity in marine situations. Each of these critiques will be graded on a 10-point basis, and a student electing the project will be required to complete all 10 critiques. In addition, the student must elect this project and so notify the instructor not later than the end of the first week of classes.

Each critique should be written in the following format:

INTRODUCTION

This section contains the following information: author's name, title of the article, title of the magazine or journal, date of publication, publication volume, and inclusive pages.

SUMMARY

The writer briefly summarizes the contents of the article in this section.

DISCUSSION

In this section, the writer discusses the strong and weak points of the article. For example - does the author meet his or her objectives; does the article follow a logical sequence; does the article agree with accepted theory; etc.

CONCLUSION

What conclusions can the reader reasonably draw after studying the article.

Each article will be evaluated according to the following scheme: 1 point for neatness; 1 point for format; 1 point for the introduction; 1 point for the conclusion; 3 points for the summary; and 3 points for the discussion.

It is possible to obtain 100 extra points from doing an outstanding job on this project. In any event, the total number of points accumulated from doing this project will be added to the other points the student accumulates.

Finally, this project is not restricted to only those students who elect the final examination. It may also be elected by students

who choose to write a major paper.

COURSE CONDUCT

The course in-class time will consist of lectures and problem-solving sessions. The purpose of the lectures is to outline and interpret information presented in the text - not to teach the text. In this regard, lecture material will be taken from a variety of sources. Students should integrate the lecture material with information presented in the student text in an attempt to conceptualize each of the major ideas which are presented.

The problem-solving session will, for the most part, be integrated with the lectures. The problems which are solved will be drawn from the lecture material per se, and from the problem sets at the end of the various chapters in the student text. Each problem, in a given chapter's problem set, will not be solved; however, it is the student's obligation to insure that he or she has gained the facility to solve the types of problems presented in the problem sets. Remember, that although the examinations are multiple choice, students will be expected to do mathematical computations in ascertaining correct answers. In order to gain this facility, it is suggested that students work through the odd-numbered problems in each problem set. The correct answer is given in the text for each of these problems.

As a supplement to the lecture, laboratory, and text information, it is suggested that students make use of the myriad of materials available in the Academy library. Many good supplementary texts are available from this source - a partial listing of which may be found in the bibliography section at the back of this syllabus. In addition, several good film loops and video tapes are available. One need only consult the card file in order to obtain their citations.

Lecture Hours. The lecture period each day, five days per week, will be of approximately two hours duration. The actual times of the lectures will vary from day to day. You should consult your instructor's schedule for the actual class meeting times.

Testing Sessions. All testing will take place during normal class periods.

CHAPTER OBJECTIVES

The behavorial objectives are listed below for each chapter in the student text, which is covered in the course. These objectives should give the student an idea of the competencies he or she should be able to demonstrate as a result of studying a given block of material. It is over these objectives that students will be tested; that is to say, examinations will be designed around the objectives listed herein.

Chapter 30. As a result of studying Chapter 30 and attending the relevant lectures, the student should be able to:

1. Define atom, nucleus, protron, electron, negative, positive, repulsion, attraction, Coulomb's law, lines of force, field intensity, conductor, insulator, K in Coulomb's law, atomic unit of charge, Coulomb.

2. Discuss electrostatic induction and its relationship to electroscope functioning.

3. Compute values of charges, forces between charges, and distances between charges in problem situations.

4. Compute values of field intensity in problem situations.

Chapter 31. As a result of studying Chapter 31, attending relevant lectures, and participating in the equipotential laboratory session, the student should be able to:

1. Discuss potential difference in terms of work and charge.

2. Describe and discuss the relationship between lines or surfaces of equipotential and lines of force.

3. Compute values of field intensity in uniform electric fields for given differences in potential, and distances between field plates.

4. Define volt, volts in terms of joules and coulombs, atmospheric electricity, ideal conductors.

Chapter 32. As a result of studying Chapter 32 and participating in the laboratory titled "Determining Single Capacitances and Series and Parallel Combinations of Capacitance", the student will be able to:

1. Define capacitance, dielectric constant, dielectric, dielectric strength, farad, microfarad, picofarad.

2. Compute values of capacitance in series, parallel, and series-parallel combinations.

3. Compute values of capacitance for given values of charge and potential difference.

4. Describe physical differences between adjustable and fixed capacitors.

5. Compute values of capacitances for given distances between plates, and for different types dielectric constants.

6. Measure the values of unknown capacitances.

7. Compute the amount of energy stored in a capacitor.

Chapter 33. As a result of studying Chapter 33 and participation in the laboratory exercise titled "Determining the Resistance of Single Resistors and Series and Parallel Combinations of Resistance", the student should be able to:

1. Define current, Ohm's law, resistivity, direct current, resistor color code, circuit symbol.

2. Compute values of series, parallel, and series-parallel combinations of resistance.

3. Measure values of resistance in series, parallel, and series-parallel circuits.

4. Identify circuit symbols of various electrical and electronic components.

Chapter 34. As a result of studying Chapter 34, attending the relevant lectures, and participating in the laboratory activity titled "Using The Wheatstone Bridge to Compute Unknown Resistances", and the laboratory activity titled "Determining The Value of Voltage of Unknown Batteries in Single, Series Aiding, and Series Opposing Configurations", the student should be able to:

1. Define electromotive force, Ohm's law for complete circuits, Kirchhoff's laws.

2. Determine values of current flow in series circuits, parallel circuits, and various legs of series-parallel circuits.

3. Measure and/or compute voltage drops across various resistors and combinations of resistances in series, parallel, and series-parallel circuits.

4. Compute values of voltage for series, parallel, and series-parallel combinations of batteries.

5. Describe the process which takes place when a battery is charged.

6. Use a sliding wire Wheatstone Bridge.

Chapter 36. As a result of studying Chapter 36, the student should be able to:

1. Describe lines of force as they relate to North and South Poles of magnets.

2. Describe the relationship between magnetic field and direction of current flow in current carrying conductors.

3. Discuss the combinatorial effects of two conductors carrying currents in the same and opposite directions.

4. Compute the force between current carrying conductors.

5. Describe the functioning of ammeters and voltmeters.

Chapter 38. As a result of studying Chapter 38, the student should be able to:

1. Define weber, electromagnetic induction, sine wave, alternating current.

2. Describe the effects of an external magnetic field upon a current carrying conductor, and a coil of wire carrying a current.

3. Discuss the relationship between current in current carrying conductors and transformer action.

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PS-2 GRADE CONTRACT

The final grade for which I plan to work is _____ .

1. In order to reach the competency level indicative of the final grade for which I am working, I will ___, will not ___ be writing outlines following the results of the respective hour examinations.

2. My intention concerning the final examination is:

   A. To take the final examination ___.

   B. To write a major paper rather than participate in the final examination ___.

3. My intention concerning the extra credit project is:

   A. To do the project ___.

   B. Not to do the project ___.

NAME _____

DATE _____

STUDENT IDENTIFICATION NUMBER _____